Can Digital Badging Help Universities Flexibly Support Students and Faculty During Crises? A Proposal and Call for Research

Terry M. McGovern
University of Wisconsin-Parkside
mcgovert@uwp.edu

Janis L. Gogan
Bentley University
jgogan@bentley.edu

Abstract

This call for research considers how digital badging could help universities serve their students better and more flexibly, especially during crises (whether caused by public health issues, social unrest, or natural disasters). Touted as a means to recognize academic achievements and skills of both traditional and non-traditional students, digital badging can support personalized learning pathways by enabling individualized portfolios of micro-credentials. Also, badges can signify mastery at more granular levels than end-of-term course grades. In this review, we identify known digital badging opportunities and threats and consider a proposed micro-credentialing system based on college course modules rather than full courses. We then articulate directions for further research, guided by the theory of IT options and debt and the theory of complementary resources.

1. Digital Badges Go to College

In spring 2020, US higher education institutions abruptly confronted a host of practical and existential questions brought on by the COVID-19 pandemic and other crises, such as the resurging Black Lives Matter movement, devastating fires in the US West, and devastating flooding in the US South. During crises, organizations that previously prepared contingency plans and put in place sufficiently flexible systems and processes are better positioned to survive [74]. Note: we know that universities worldwide were also beset by the pandemic and social and natural-disaster crises. This paper is admittedly US-centric, because both authors teach in US universities.

In this paper, we consider how digital badges -- "Web-based tokens of learning and accomplishment" [6] – could help US universities respond flexibly during crises. We articulate the case for applying digital badging solutions in undergraduate and graduate information systems (IS) programs, first for use within a program and university, and potentially later to support broad inter-university programmatic collaboration.

To date, no study has proposed how or why badging could improve a universities' crisis response. However, many universities in the US and elsewhere have experimented with digital badging [1, 11, 17, 19, 29, 38, 81, 78] and evaluated its use in courses in chemistry [16, 71], computer information systems [22], software engineering [54] expository writing [31], library management [23, 72], nursing [20, 64, 75], medicine [45, 52], and teacher education [10, 48]. Some college initiatives focus on developing badged portfolios that capture evidence of students' participation in internships and other co-curricular activities [5, 12] Badging solutions can also support lifelong learning [12, 25, 53] for a wide range of constituents, including informal learners (e.g., participants in non-credit MOOCs [7, 19, 37]), informal learners attempting to transition to for-credit programs [38], and professional development programs [14, 28, 55]. Prior studies also reveal that badging helps universities serve a more diverse set of students, by offering both degree- and/or certificate-granting programs, within a university or program or in collaboration with other universities [76]. Proponents claim that badging can improve student motivation [8, 63] and help universities improve student retention [21, 44] particularly when combined with gamification [56]. Efforts are also underway to improve the reliability of micro-credentialing, by incorporating blockchains into digital badging systems [32, 33]].

We propose that *digital badging can help formal learners study on more flexible and personalized pathways.* We further propose that, when designed for temporal and institutional flexibility, *digital badging systems can help universities support and retain a diverse set of students and faculty during crises*. Digital badging may help colleges become safer, more inclusive, more efficient, and more nimble in responding to rapidly-changing circumstances.

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In the next section we begin to lay out the case for how digital badging systems and processes can support flexible response to crises and other rapidly-changing circumstances in higher education, by briefly reviewing the extraordinary circumstances the US confronted in 2020. In Section 3 we review relevant prior studies of digital badging impacts and challenges in higher education. In Section 4 we explain our focus on IS curricula and then describe some digitally-badged IS course design scenarios. In Section 5 we discuss a few potentially-useful theories to inform future studies on whether and how digital badging systems support flexible university responses under crisis conditions, and whether this translates into improved outcomes in terms of student learning and retention. We conclude in Section 6, with suggestions for next steps in a long-term research agenda.

2. Crises and Responses in 2020

In spring 2020, traditional place-based US universities, coping with COVID-19 disruption, began to redesign spaces and services to support cautious social distancing. They also began to rewrite their contingency plans to specify circumstances that would trigger decisions to move teaching fully online.

In March, after announcing that residential students should vacate college campuses, some administrators were surprised to learn of students who were homeless or who lacked resources needed to work effectively online. Administrators also learned that some students worked in jobs that put them at high risk of getting sick, or that limited their ability to attend some virtual class sessions. Burdens such as these fell more heavily on low-income families, especially Black families and other disadvantaged groups [11, 46].

When a student or colleague fell ill or faced untenable conditions at home (due to ill relatives, child-care, poor connectivity, or insufficient space and tools), it often fell on instructors to improvise solutions (while meanwhile scrambling to learn how to teach online and cope with their own challenges at home).

In preparation for Fall 2020 and aiming to blend face-to-face learning and online learning, many universities outfitted traditional classrooms to support hybrid delivery (fewer students in widely-spaced classroom seats; other students synchronously or asynchronously online). Dormitories were renovated to protect student safely (such as by converting rooms from doubles to singles and creating quarantine spaces). Also, many universities took steps to make better use of classroom and dormitory facilities year-round, to increase students' flexible options. By Fall, most academic leaders came to accept that social distancing and high uncertainty would be key elements of a "new normal." They continued to brainstorm ways to deliver safer, more inclusive learning experiences.

3. Relevant Prior Empirical Research

Digital badging makes it possible to record more-granular and portable evidence of student learning achievements than is currently captured in end-of-term course grades. A digital badge, representing a skill, learning achievement, or experience [49], can be earned in online or offline for-credit courses or in less formal contexts. Many digital badges are represented by unique images (thus the term "badge") and every digital badge contains metadata that describes what it represents and evidence supporting that designation.

Literature reviews [25, 40, 52], books [27, 50], and a study of prominent badging proponents' views [6] contend that to date, empirical research on digital badging in higher education is in an early stage. A recent review concluded: "The results indicate a growing momentum for the use of digital badges as an innovative instruction and credentialing strategy within higher education," but that much more research is needed to identify optimal implementation tactics [68].

Digital badging studies have yielded equivocal findings on some topics. In primary and secondary education and extra-curricular or informal contexts, proponents argue that badges are potent symbols of achievement [57]. In post-secondary education, this symbolic function might be less strong. In traditional for-credit college programs, do digital badges increase students' discipline, engagement, interaction, and/or motivation? Studies addressing these aspects are inconclusive; see Table 1. In one action research study, college students viewed badges as "childish" when awarded for related non-course activities [11], and similar negative results were reported in the context of a graduate Library Management course (which awarded badges to students who earned grades in the A range): "Students were underwhelmed by the experience in terms of their motivation [and badges'] perceived usefulness" [23]. In a graduate teacher education course, badges enhanced student interaction but did not influence their class participation [9], whereas students in a f2f graduate pharmacy course were enthusiastic about a voluntary badging program [16], as were nursing students in a hybrid (offline + online) course [64]. Graduate students in an online web development course were enthusiastic about digital badges that represented peer evaluations [54].

Some digital badging studies moved beyond acceptance, engagement and motivation to test learning outcomes [26]. Ataturk University undergraduates earned achievement badges at three levels of mastery (beginner, intermediate or advanced) for each 4-week

module of a programming course. That study reported that badging positively impacted students' motivations, study habits, and final course grades [78]. Purdue University students in a large f2f undergraduate science class received badges for videos they produced to correctly demonstrate "how to use a 10mL pipet to dispense liquid." More than 90% of badge-awarded students correctly answered an exam question about pipetting technique [71]. Yet, in another well-designed study, involving an open-access online course on computer-mediated communication, badges did not measurably impact students' intrinsic motivation, engagement, or final grades. One intriguing finding from that gamification study: students rated publicly-visible badges more negatively than students whose badges were not publicly visible [36]. This suggests that in some contexts, students value badges for the feedback they convey, but not necessarily for their symbolic representation of achievement.

In a large educational technologies course, students who were awarded achievement badges earned higher grades than students in a non-badging condition (working on the same assignments) [51]. In an online undergraduate information systems course, badges awarded for exceptional academic achievements (e.g., solving a problem with no mistakes or submitting a correct answer several days early.) had a small but statistically-significant impact on student behavior and attitudes [22]; however, some students expressed initial enthusiasm that shifted to boredom. Undergraduates in an online programming course disliked achievement badges, while those in an online teacher education course liked them. In both of these University of Stockholm gamified courses, a "progress bar" depicting student mastery of various skills was well received [55].

As briefly discussed above, some prior studies focused on how digital badging affects student engagement and motivation, and some studies tested for learning outcomes. Our research focus is more consistent with the latter concern: From the programmatic perspective, in circumstances when a student's participation in a course is interrupted, can a digital badging system make it possible and cost-effective to certify students' mastery of course modules, in a stackable automated mode that enables the student to earn a legitimate full-course grade? In such circumstances, the sidelined student can resume course work at a later time, possibly with a different instructor and possibly even at a different institution. Universities already deal with special circumstances (e.g., a student becomes temporarily incapacitated midway through a course, yet completes it through a flexible arrangement, often at the discretion of the instructor). However, the cost of such arrangements is relatively high, since they are not based on automated systems or structured repeatable processes. We further recognize that modular course designs (an important element of our solution) can support better flexible arrangements, with or without digital badging. However, since digital badging solutions can be highly automated, a university's cost to administer stackable course module badges should be quite low (once a system is developed and in routine use).

4. Badging Scenarios in IS Curricula

This paper focuses on digital badging systems' micro-credentialing potential (verifying a student's accomplishments in each course module, so the student earns credit, even if their coursework is interrupted). For purposes of illustration, we choose to focus on Information Systems, since this discipline "has an increasingly strong foundational role in understanding, explaining, and continuously improving how most organized human activities work and can be improved," and thus both IS programs and IS modules in other courses are likely to be important in the coming decades (69, p. 3). We further argue that at undergraduate and graduate levels, model IS curricula have been proposed by the ACM and AIS, who recognize information systems as a profession, subject to knowledge and skill standards [70]. It is thus possible to specify skills and learning objectives for courses making up an IS degree program or for an IS course taught in a business curriculum. In our brief literature review above, digital badging studies in the more highly-defined college courses (chemistry, computer programming, web design, pharmacy) demonstrated positive learning outcomes. Thus, it seems likely that digital badging is also potentially useful for well-specified university-based under-graduate or graduate-level IS courses and programs. We further propose that as a foundation technology for a well-designed micro-credentialing system and associated processes, digital badging can effectively address known challenges encountered during pandemics and other disruptive crises, including in situations when a student falls ill; a student with difficult financial or home circumstances cannot effectively participate when a course abruptly moves online; or when a colleague must substitute for an incapacitated instructor..

One of the authors teaches a required MBA case-method *Strategic IT Management* course. In 14-week f2f or hybrid mode, this course meets once a week for about 2 ½ hours. In Week 1, Instructor lays out course requirements and conducts a short case discussion. In each of 12 sessions in Weeks 2-13 a "Harvard-style" strategic IT management case is discussed, and in

Week 14, a final exam requires students to analyze a similar case. The course has a 3-module design, for which the three topics have not changed for more than ten years (Module A, weeks 2-5: IT for Business Value. Module B, weeks 6-9: Risks in IT Projects and Operations. Module C, weeks 10-13: IS Planning and Governance). In each module, students read, analyze and discuss a case each week (4 cases per module). Modules B and C build on foundational technical and strategy concepts established in Module A, but B and C are independent of each other; either module can be delivered as the second or third course module. This course is also offered in 6-week writing-intensive asynchronous online mode; it aligns with the 14 week version through the 3-module design and assigning the same cases and readings. However, since that course is writing-intensive; students are graded on their best 10 case analyses plus a case-based final exam.

Since learning objectives are aligned across modes, in all versions of this course four badges would be issued (one badge per module, one badge for the final exam). In Scenario 1, a student in a traditional or hybrid class misses most of Module B. Before being permitted to sit for the final exam, they take Module B As soon as they can fit into the 6-week asynchronous version is offered, traditional section, or hybrid section. In Scenario 2, Instructor falls sick early in a module. Substitute fills in to complete one or more modules, including grading all submitted work in the applicable module/s. An instruction database could be set up to automatically note when Instructor "owes" coverage to Substitute (in that course or another for which Instructor is qualified), and/or register a credit for Substitute, toward future time off.

Other 3-, 4-, 5- or 6-badge courses could be personalized to students' varied career objectives and interests. Example: an elective 6-module Strategic IT Management course might devote modules A, B and C to less-extensive coverage of Strategic IT Management topics (and with module grades based on participation, written work, and/or quizzes). In module D, each student reports on IT issues in a particular function (e.g., marketing, finance). In Module E, they report on IT management issues in a particular industry (e.g., healthcare, hospitality, retail). In Module F they report on technical or ethical topics. Half of this elective is personalized to students' professional interests.

Based on 12 middle weeks of a 14-week semester, other courses can sub-divide work into 3-, 4- or 6-module designs. A course that covers many instances of a broad topic – such as Digital Innovation -- works well in 6-module form. That course is designed around a technologies-of-interest list (e.g. lists produced by the Society for Information Management, IT research firms Forrester or Gartner, industry associations like the AICPA, or consultancies like McKinsey). A 2-week module A introduces students to ten technologies of interest, and topics like diffusion of innovations, disruptive technologies, and ambidexterity (quiz for Badge 1). In the next five 2-week modules (B, C, D, E, F), some students present reports on that module's topic, and student observers critique their work. Each student thus would earn one Reporting badge and 4 Critique badges. A final examination assesses students' understanding of higher-order technical and business digital innovation topics and their application to particular situations (Badge 6). A student missing two weeks' work would make it up by repeating one module (if calendar cooperates) or two modules (if the two missed weeks span two modules).

Thus, badging can increase student and instructor flexibility within a college, IS program and (we propose) in many other programs of study that are amenable to modular course structures. Our proposed micro-credentialing digital badging system relies on a modular course structure, yet we note that institutions can surely derive benefits from modular course structures with or without a digital badging solution. All students can benefit from approach to micro-credentialing, and those students in challenging circumstances may derive the greatest benefit, since badging strongly supports flexibility and portability.

Badging can also support inter-institutional collaboration. Articulation agreements (recognizing other colleges' courses) already exist today. Expanded articulation agreements can add value for students, by enabling them to take digitally-badged specialty courses or course modules from other colleges, and possibly also from professional- or business-based certification programs (such as those offered by ISACA, Google and Microsoft). Supported by reliable and secure software, the operational costs to transfer credits across institutions should be low (once an interoperable platform-based system is developed to automatically reconcile digital badges to course grades). This more expansive inter-institutional context will also bring many additional challenges, in terms of interoperability and quality standards, accreditation issues, and the varied perspectives of a larger set of stakeholders [35]. Lastly, we note that our proposed solutions emanate from our perspectives as US-based college professors. Inter-university solutions that cross national boundaries will bring further challenges.

5. Directions for Future Research

Having laid out our argument for a proposed micro-credentialing system for modular-design IS courses, we now consider research opportunities.

Action research in the design science tradition can begin to accumulate empirical evidence on the technical, operational, and economic feasibility of these ideas. Such studies will follow an already-vibrant digital badging research tradition of evaluation studies.

While many prior digital badging studies focused on individual acceptance, motivation, and/or engagement, few studies have been informed by IS-specific or organization-level theories. To address this gap, new empirical studies could usefully draw on two theoretical foundations: IT options and "debt" theory, and the theory of complementary resources. Each theory reflects essential characteristics of software:

- Software is malleable; it can be modified to improve its utility and functionality.
- Software is renewable; an application can be reused or transferred without being depleted.
- Some information systems contribute value by substituting data for physical resources (e.g., real-time data disintermediates a supply chain; online collaboration tools substitute for classrooms).
- An information system can contribute value by complementing physical products.

These characteristics combine to confer future value, as digital options [66], which we discuss next.

5.1. Balancing IT options and debt

New systems can increase an organization's digital options for future value. Or, they can constrain future value, giving rise to technical debt ("debt," because of the time and effort is necessary to overcome these constraints [77]). Digital option value derives from design elements like modularity, layered architectures, and technical expertise [77]. Technical debt can arise from rational short-term design decisions that reduces the value of an option. For example, in the 1960s and 1970s, punch-card limits led developers to rationally represent "year" with two digits instead of four. That design choice brought technical debt; the "Y2K bug" needed to be addressed in the nineties, in order to prevent problems in a host of IT-supported systems, devices and processes due to potential date-sensitive systems disruptions. Some technical debt arises from less-rational decisions. For example, elegantly designed but poorly documented software may be difficult to maintain/improve over time. Also, data that does not conform to an industry-standard format may be difficult to later integrate with conforming data.

Woodard et al. [77] (2013) offer guidance for chronicling organizations' IT-related design moves over time, to depict each move's effect on option value and technical debt. New digital badging studies can use this approach to identify whether and how specific design choices that bring short-term benefits today increase technical debt (such as by neglecting documentation clarity for the sake of swift system development) or whether and how specific rational design choices reduce future digital option value (such as by choosing not to conform to digital badging meta-data standards set by OBI, the IMS Global Open Badge Infrastructure, to support badge transferability. Such studies should shed helpful light on questions of how and why effective digitally badged micro-credentialing solutions are built in higher education.

5.2. Resource complementarity

The Resource Based View addresses individual, group, organizational, and industry levels of analysis [30]. Valuable assets and capabilities ("resources") that are rare, inimitable and non-substitutable can confer competitive advantage [3, 58]. IT planning (an organizational capability) [43] improves organizational agility [42], and systems design know-how and agile development are also organizational capabilities that contribute value. Thus, individual- or group-level digital badging expertise should, over time, give rise to an organization's digital badging capability, which may confer competitive advantage.

A longitudinal single-case or multiple-case study would be a helpful method for learning how individual developers' capabilities and complementary resources "roll up" to an organizational digital badging capability in higher education. Such studies would benefit from recognizing that most resources, on their own, are not sufficiently valuable to confer competitive advantage; thoughtfully configured bundles of complementary resources are necessary [68], and these resource bundles are particularly valuable when difficult for competitors to imitate [59]. IT management [4], supply chain management [60], and information management [46, 47] are important high-level IT-related capabilities that are supported by other complementary resources, so digital badging is likely to also rely on complementary resources, which have yet to be identified in prior studies. Dynamic capabilities adapt to changing conditions [13, 15, 39, 41, 60]. These are difficult to develop and sustain – especially those that rely on rapidly-evolving information technologies [28]. Furthermore, a resource or bundle of resources is not inherently complementary [75]; specific resources may be complementary in one context and neutral in others.

Thus, in the context of IS, the theory of complementary resources [2, 13, 47, 62, 67, 73] states that within resource bundles, some resources must have complementary effects, and other useful resources may be neutral with respect to complementarity. To

date, no study has closely examined a digital badging initiative through this lens of resource complementarity. Here is one specific aspect of complementary in this context: a digital badge can contain an expiration date, to signify that the skill or knowledge it represents is perishable (true with language- or product-related coding skills. For example: while Visicalc and Lotus 1-2-3 spreadsheet skills are obsolete, Microsoft Excel continues to lead in the spreadsheet segment). On a more basic level, a study based on the theory of complementary resources would identify whether and how a badging system for modular micro-credentialing is interdependent with other systems and processes, and whether and how it gives rise to new processes, relationships, skills, and structures. Such a study could make both a theoretically-important contribution and yield helpful results to guide practitioners.

5. Conclusions

Our basic argument is that digital badging offers cost-effective flexibility that can improve universities' responses to crises, by giving faculty and students temporal, geographic, and financial flexibility. In turn, badging should help improve public health outcomes in the current pandemic, while improving education access, diversity, and inclusion, which can help a university continue to thrive in the face of other rapidly-changing circumstances. Our argument is based on strong first-hand experience as US college professors, yet it seems likely that digital badging solutions based on micro-credentialed course modules might also be valuable in many contexts beyond the US. The three forms of hypothesized flexibility (temporal, geographic, financial) provide a minimal necessary structure for designing further studies on this topic, based on a variety of research methods, and set in a variety of national and pedagogical contexts.

A necessary first step for action design research focused on IS curricula is to design undergraduate or graduate IS courses in a modular form suitable for micro-credentialing. Whether offered in a 3-, 4-, 5-, or 6-module design, each course module should address a well-defined theme, and students should be assessed in light of clearly-specified learning objectives for that module. Some colleges may find that modular course designs are inherently beneficial, even if financial constraints prevent them from moving to a full digital badging solution. We believe that modularity provides a helpful foundation that supports a digital badging option when these universities are ready for it.

Other administrators will see a compelling near-term opportunity: once a digital badging solution is in place, incremental costs to maintain or enhance it should be low (most necessary tasks associated with badging can be automated), and the temporal, geographic and financial benefits to faculty and students can be high. For colleges that do move forward, it seems prudent to first implement digital badging in a few courses. Treat each course as a pilot test, with a strong experimental design to gauge outcomes (including student engagement, achievement, and other variables). After a few badged courses are evaluated, carefully select other courses, based on variables of interest (e.g., number of modules per course, required versus elective courses, extent to which each course is highly or loosely structured, emphasis on skill acquisition versus knowledge application, etc.). By the time several courses have been evaluated, one or more digital badging champions may emerge among the faculty; capitalize on their enthusiasm. Provide funding for them to attend standards-setting meetings and relevant conferences, so they can join the emergent community of digital badging scholars (and will thus be poised to help implement shared curricular and flexible value-added cross-institutional innovations, once the college has attained sufficient expertise to be ready for next steps).

Although proponents contend digital badging is a potentially transformative or disruptive innovation for higher education [29, 31], prior badging studies report equivocal results, in terms of college students' motivations, engagement, and academic achievements. These mixed findings suggest that implementation contingencies are not yet well understood in this domain; many more studies are needed, and these should go beyond the focus on individual students' attitudes and outcomes. A common thread in prior findings is that as college students mature, they are not particularly swayed by uses of badges that are merely symbolic or fun; most college students are pragmatic and more likely to accept those badging use-cases that help them learn more effectively and cope with unexpected developments. Modular course badging can certainly help provide needed flexibility, and in many cases it should also support student learning (since a student who does not feel well or is otherwise struggling to cope with an unfolding crisis is not likely to learn as effectively as one who deals with the crisis circumstances directly and then returns to study when they are better prepared to learn).

Prior research on the theory of digital options and debt and the theory of complementary resources lead us to hypothesize that digital badging systems can contribute value, when coupled with complementary assets and capabilities. We also hypothesize that past and future digital badging system design decisions will create both digital options and technical debt. However, digital badging is so new in the context of

higher education (especially for the purpose proposed here), there is still plenty of scope for other exploratory studies to learn more about the many interacting stakeholder and structural and other factors that can affect whether and how micro-credentialing modules take hold at all, and whether and how universities and their students and faculty are able to benefit from the flexibility they offer.

We propose studies at the organizational level, and yet to the extent that case studies and other qualitative methods are chosen, there will likely also be opportunities to gather interview data to investigate some higher education leaders' take on industry-level factors that do or could influence digital badging success. We have stated that we expect any institutions who choose to implement our idea would initially carry it out within a single degree program offered at that university. However, we have also noted that the long-term possibility is strong but complicated for interesting new inter-institutional arrangements that go well beyond conventional articulation arguments. Yet, this is just the tip of a growing iceberg. Many college presidents are closely following the weaker institutions around them, some of which will fail in the next two years, and others of which will join forces into new institutions. Meanwhile, it is quite possible that born-digital organizations offering college-level courses will gain facility with digital badging much earlier and prove to be a disruptive threat. So, while our interest is currently driven by a desire to serve our students and faculty better with more flexible options, we are mindful of other pressing competitive concerns.

IT innovation journeys require some big decisions and many small steps; the same is true of meaningful digital badging innovation in higher education. We hope some HICSS participants will become digital badging champions for the flexible-options approach described here, and that they and others will join us in conducting carefully designed studies to critically assess digital badging opportunities, and prepare for the next wave of challenging crises.

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Table 1 Findings: 16 Prior Empirical Studies of Badging Effectiveness in Higher Education

	Findings	F2F	Online	For-Credit	Non-credit	Faculty-awarded	Peer-awarded	Context and Focus
GRADUATE								
2013 O'Connor & McQuigge	+		√				√	Students judged peers' web designs
2017 Fajiculay et al.:	+	√		√		√		voluntary badging participation
2018 Chou & He	mixed	√	√	√		√	√	badges for participation, peer evals
UNDERGRADUATE								
2015 Fanfarelli & McDaniel	mixed		√	√				student behavioral characteristics
2015 Hakulinen et al.	+		√	√		√		badge=symbol; effect on motivation
2015 Olsson et al.	mixed		√	√				neg: badges +: progress bars
2015 Reid et al.	mixed			√				expectancy, badge, motivation
2015 Towns et al.	+	√		√		√		badges for students' pipetting videos
2016 Harmon & Copeland	negative			√	√	√		badges for high grades
2016 Hatzipanagos & Code	mixed		√				√	negative finding: motivation
2016 Yidirium et al.	+	√		√		√		learning style, badges, motivation
2017 Fanfarelli & McDaniel	mixed		√	√				more badges, higher engagement
2017 Rohan et al.	+			√		√		Blackboard + badges (complements)
2018 Coleman	mixed	√			√			badges for non-class experiences
2018 Kyewski & Kraner	negative		√	√		√		large open-access course
2020 Newby & Cheng	+	√		√		√		Ed tech course, 75%-82% female